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[10191/1825]

RADIO RECEIVING SYSTEM AND METHOD OF OPERATING SAME

[Field of the Invention
]FIELD OF THE INVENTION

The present invention relates to a radio receiving system and a method of operating a radio receiving system having a []radio []data []system radio receiver (RDS radio receiver) having an RDS processor and a plurality of receiving antennas connected to the RDS radio receiver via an antenna switching system[, according to the generic part of Claim 1. The present invention further relates to a method of operating a radio receiver system having a radio data system radio receiver (RDS radio receiver), an RDS processor and a plurality of receiving antennas connected to the RDS radio receiver via an antenna switching system, according to the generic part of Claim 7.

Background Information
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BACKGROUND INFORMATION

In radio receivers having an evaluation unit for the radio data system (RDS radio receiver), [as,]for example, RDS auto radios[, it is known], during poor signal or receiving quality[, to conduct] a test for alternative frequencies (AF)[,] may be conducted and possibly [to]a change to an alternative frequency [(AF)]may be made if [it]such change yields a better signal or receiving quality.

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The so-called RDS (radio data system) signal is used with wireless program broadcasts, for example, of radio programs for travelers in a motor vehicle equipped with a corresponding RDS auto radio, for transmitting various [important]data, with which the RDS auto radio carries out, independently and automatically, among other things, a plurality of operations necessary for interference free reception, without, for example, a driver having to divert his attention from the road traffic and having to make manual inputs into the RDS auto radio. In that regard, an RDS processor, provided in the RDS auto radio, carries out an RDS-controlled selection of an actual reception frequency. In this process, for example, alternative frequencies stored in an alternative frequency list are checked regularly, and signal strength, signal quality as well as an RDS error rate are evaluated, and that particular reception frequency is set in the RDS auto radio, which offers optimal broadcast reception in consideration of the aforesaid measured values.

In broadcast receivers having a plurality of reception antennas[it], there is[also a matter of knowledge to] provided an antenna switching system, which, analogously to the RDS processor, checks a signal strength and a signal quality coming in over a specific reception antenna, and selects and connects to the broadcast receiver the particular reception antenna which guarantees optimal reception. [But here the disadvantage is]However,[that] in an RDS auto radio having a plurality of reception antennas[,] and an antenna switching system for automated switching among the reception antennas, the processes of antenna switching and alternative frequency selection are two competing operations independent of each

other. The antenna switching system also does not evaluate an RDS error rate. Therefore, these two systems work in uncoordinated fashion, although they do influence each other in their effect on reception quality. In borderline situations, the result can be a deterioration of reception instead of an aimed-at improvement.

[Description of the Present Invention, Object, Solution, Advantages

It is the object]SUMMARY OF THE INVENTION

An exemplary embodiment of the present invention is directed to [provide]providing an improved radio reception system [of the kind named above,]and a corresponding exemplary method for operating the same[, while removing the disadvantages named above.

The object of the present invention is achieved by a radio receiving system of the type mentioned above, having the features indicated in Claim 1, and by a method of the type mentioned above, having the features denoted in Claim 7.

To accomplish this, in a radio reception system of the type named above,].

The exemplary embodiment of the present invention provides that the antenna switching system for carrying out switching operations from one receiving antenna to another receiving antenna [shall]can be directly connected to the RDS processor via a control device.

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[This has]The exemplary embodiment of the [advantage]present invention further provides that [a particular]an antenna selection can take[s] place even under consideration of an RDS error rate checked by the RDS processor[, and therefore being]. It is believed that this provides a substantially more [accurate,]accuracy and the antenna selection by the antenna switching system and a reception frequency selection by the RDS processor [being]are no longer two competing, independent processes. Instead,[but] the antenna selection [being]is integrated into the RDS strategy. This can avoid[s], for example, problems which would arise from different time constants of the processes named.

[Preferred further developments of the radio receiver system are described in Claims 2 through 6.

In a preferred specific embodiment]In another exemplary embodiment of the present invention, the control device includes a control line which has, in particular, a single control wire, which transmits different currents, for instance, 0 mA, 2 mA, 4 mA, or 6 mA to the antenna switching system as switching commands.

[An interface is preferably]In another exemplary embodiment of the present invention, an interface can be positioned between the antenna switching system and the RDS processor for evaluating control commands of the RDS processor.

In order to have loss-free and operationally safe switching between the receiving antennas, the antenna switching system can include[s], for each receiving antenna, an HF switching

unit connected to it and the RDS processor via the control device, which is, for example, a coaxial relay or a PIN diode-HF switch.

[Furthermore, in a method]Another exemplary embodiment of[the type named above,] the present invention provides that the antenna switching system for carrying out switching operations from one receiving antenna to another receiving antenna [shall]can be controlled by the RDS processor.

[This has]In exemplary embodiments and/or methods of the [advantage that]present invention, the selection of [any particular]an antenna [is]can be made even under consideration of an RDS error rate checked by the RDS processor, and therefore substantially more accurately[, t]. The antenna selection [being no longer]in this case is not made up of two competing, independent processes[,] because of the antenna switching system and a reception frequency selection[, but rather] and the antenna selection [being]is integrated into the RDS strategy. [This avoids, for example,]Thus, it is believed that problems [which]can be avoided that would arise from different time constants of the processes named.

[A preferred further development of the method is described in Claim 8.

In one preferred further development of the method]In another exemplary method of the present invention, a control current of 0 mA, 2 mA, 4 mA, or 6 mA is transmitted from the RDS processor to the antenna switching system for the purpose of switching among various receiving antennas.

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[Brief Description of the Drawings

With the aid of the enclosed drawing, the present invention is described in more detail. This shows, in the only Figure,]BRIEF DESCRIPTION OF THE DRAWING

The Figure shows a schematic block diagram of a[preferred]n exemplary embodiment of the radio receiving system according to the present invention.

[The Best Way to Execute the Present Invention

The preferred embodiment, shown in the only Figure,]DETAILED DESCRIPTION

Referring to the Figure, an exemplary embodiment of a radio receiving system 100[,] according to the present invention[,] is shown and includes an RDS (Radio Data System) radio receiver 10, an antenna switching system 12 and a plurality of alternative receiving antennas 14. The RDS radio receiver 10 can ha[s]ve an RDS processor 16, an antenna input 18 and a control line output 20. The antenna switching system 12 [is]may be connected to the receiving antennas 14 via the respective amplifiers 21 and the respective HF switching units 22, 24, 26, and 28. The HF switching units 22, 24, 26 and 28 [are]can each be connected to antenna input 18 of the RDS radio receiver 10 via a common amplifier 30. By the corresponding selection of the setting of the HF switching units 22, 24, 26 and 28, a desired receiving antenna 14 can be connected to antenna input 18 of radio receiver 10.

The HF switching units [are]can be connected to an interface 34 via the respective lines 32, for carrying out the respective

switching processes from one receiving antenna 14 to another receiving antenna 14. Th[is]e interface 34 [is]may be coupled with control line output 20 of the RDS radio receiver 10 via a single control line 36. According to the exemplary embodiment of the present invention, the RDS processor 16 can check[s] signal strength, signal quality and an RDS error rate not only for different alternative frequencies, but also for different receiving antennas 14. For this, the RDS processor 16 gives a corresponding control command via control line 36 to interface 34, which, corresponding to this control command, switches the HF control units via the lines 32 in such a way that a desired receiving antenna 14 is connected to antenna input 18 of RDS radio receiver 10. By evaluating the measured values for signal strength, signal quality and RDS error rate, the RDS processor can select[s] an optimal alternative frequency as well as an optimal receiving antenna 14. This selected receiving antenna 14 [is]can be connected to antenna input 18 of the RDS radio receiver 10 by a corresponding control command via control line 36 to the interface 34.

The control command transmitted from the RDS processor via control line 36 [is]can be, for example, a control current which may assume a value such as 0 mA, 2 mA, 4 mA or 6 mA. In this connection, for example, the interface 34 switches the HF switching unit 22 to pass[,] and the remaining HF switching units 24, 26, 28 to block, when the control current has the value 0 mA, so that the left antenna 14 in the[only] Figure is connected to antenna input 18 of the RDS radio receiver 10. In an analogous manner, interface 34 switches HF switching unit 24 to pass and the remaining HF switching units 22, 26, 28 to block when the control current has the value 2 mA. Likewise,

the interface 34 switches HF switching unit 26 to pass and the remaining HF switching units 22, 24, 28 to block[,] when the control current has the value 4 mA. Likewise, [or]the interface switches the HF switching unit 28 to pass and the remaining switching units 22, 24, 26 to block when the control current has the value 6 mA. In this manner, it can be seen that always exactly one receiving antenna 14 is connected to the antenna input 18 of the RDS radio receiver 10.

[Thus, selecting the antenna is done, a]According to the exemplary embodiments of the present invention, selection of the antenna is done, not independently by the antenna switching system, but rather centrally controlled by the RDS processor, which also selects an alternative frequency. In other words, the selection of the best receiving antenna 14 is transmitted to an additional software routine in RDS processor 16. On account of this, an RDS error rate is also considered jointly with the antenna selection, which reacts substantially more sensitively to changing reception conditions than does the signal strength or the signal quality. Through this, antenna switching can occur even earlier, that means[,] before a listener can perceive a change or a deterioration of an audio signal emitted from the RDS radio receiver. An antenna evaluation set of statistics simultaneously kept in the background makes possible minimizing the switchover operations and interfering noise caused by them. The HF switching units 22, 24, 26, 28, provided for bringing together[the], for example, the four antenna signals to the sole antenna input 18 of the RDS radio receiver 10, may be, for instance, switching elements in the form of coaxial relays or PIN diodes-HF switch.

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[F]In exemplary embodiments of the present invention, for rapid switching[, in the preferred specific embodiment depicted], a single-wire control interface 20, 36, 34 to the above-mentioned four different control signals 0 mA, 2 mA, 4 mA and 6 mA [is]can be provided. These control signals [are]can be generated, for example, by a controlled current source[, not shown,] and [are]can be decoded using a voltage divider[, not shown,] and an accompanying comparing element. In this manner, a switching control working at high speed over a single line [is]can be realized that is safe from interference.

The software solution in the RDS processor 16, [mentioned as an]for example, can easily be integrated into the existing system, without substantial new development of the RDS processor 16[per se], whereby simultaneously the relatively high cost of the independent antenna selection by the antenna switching system 12 [is]may be completely eliminated. In particular, a ZF interface, essential to customary antenna switching systems at the RDS radio receiver, can become[s] superfluous. The total wiring can become[s] more favorable since a ZF coaxial connection is no longer needed, but rather control of antenna switching [is]can now be performed only via a single-wire line.

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ABSTRACT OF THE DISCLOSURE

[Abstract

The present invention relates to a]A radio receiving system [(100)]having a []radio []data []system radio receiver (RDS radio receiver[(10)]), having an RDS processor[(12)] and a plurality of receiving antennas [(14)]connected to the RDS radio receiver [(10)]via an antenna switching system[(12)]. [In this connection, t]The antenna switching system[(12)] for carrying out switching operations from one receiving antenna [(14)]to another receiving antenna [(14) is]can be directly connected to the RDS processor [(16)]via a control device[(36, 34)].

[(Figure)]

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